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HENRY W. HENSHAW, CHIEF OF BUREAU

THE MAMMALS OF BITTERROOT VALLEY,
MONTANA, IN THEIR RELATION
TO SPOTTED FEVER

BY

HENRY W. HENSHAW
Chief, Biological Survey

AND

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United States Department of Agriculture,

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THE MAMMALS OF BITTERROOT VALLEY, MONT., IN THEIR RELATION TO SPOTTED FEVER.

By HENRY W. HENSHAW, *Chief, Biological Survey,*

and

CLARENCE BIRDSEYE, *Assistant, Biological Survey.*

INTRODUCTION.

The present report contains the results of investigations carried on from March 12 to July 14, 1910, and continued in 1911 in cooperation with the Bureau of Entomology and the State Experiment Station of Montana. In addition it embodies numerous data obtained by assistants of the Biological Survey in previous years.

As has long been known, the so-called spotted fever of many parts of the Rocky Mountain region is peculiarly virulent in Bitterroot Valley, Mont., and the present investigations were undertaken for the primary purpose of ascertaining the particular species of wild mammals in and near the valley which harbor ticks, especially the form *Dermacentor venustus*, believed to be chiefly responsible for the spread of this fever. Incidentally also it was intended to obtain ticks in various stages of development for determination and study by the Bureau of Entomology and for experimental purposes. It was further expected that in the course of the season's trapping animals stricken by the fever would be taken which might be made to yield valuable data regarding the etiology of the disease. But the untimely death in Mexico of Dr. H. T. Ricketts, who had planned to carry on these studies, put an end for the season to this part of the investigation, and, although animals were trapped showing unmistakable signs of disease, in the absence of experts in this branch of the work the nature of the sickness could not be determined.

The almost complete restriction of the fever to the western side of the valley has occasioned much speculation and given rise to

a theory of its possible connection with some native mammal or mammals living solely on that side; but a study of the range of the mammals of Bitterroot Valley has failed to show that a single species is restricted to the western side. Nevertheless the two sides differ physically so widely as to influence greatly the distribution of mammals. On the west side the mountains rise abruptly, forests or brush covering much of the land except the cultivated tracts; while on the east side a strip of rolling, treeless, sage-covered bench land lies between the river and the mountains. Thus the west side has a somewhat more humid climate than the east, with heavier growth of brush, which furnishes good cover for most of the small mammals, and hence favors the presence of ticks. But on the opposite or less humid side good "tick country" occurs only around those ranches which nestle close up to the mountains. Ground squirrels, chipmunks, woodchucks, and pine squirrels—animals which were found to be the principal hosts of the nymphs and seeds of the fever tick (*Dermacentor venustus*)—are mainly absent from the broad strip of sage-covered bench land; but as this land is now being rapidly brought under cultivation, some of these small mammals may be expected sooner or later to occupy it. Hence, though the east side of Bitterroot Valley is at present less suited as a habitat for the several wild mammal hosts of the fever tick, a study of the habits of the mammals of the west side discloses no apparent reason why the spotted fever should not in time be carried to the east side.

In the course of our investigations more than 500 mammals were collected in and around the valley and 20 species were found to carry ticks either in the immature or adult stage. The hosts of fever ticks fall naturally into two groups, those that harbor chiefly adult ticks and those that harbor the younger stages. In the former class belong mountain goats, bears, coyotes, badgers, woodchucks, and possibly elk, deer, mountain sheep, rabbits, and domestic stock, as horses, cattle, and sheep. Those of the second class, mainly rodents, comprise ground squirrels, woodchucks, chipmunks, pine squirrels, mice, and wood rats.

DOMESTIC STOCK.

Unquestionably the great bulk of fever ticks which become engorged in the Bitterroot Valley do so on domestic stock. These animals are much more numerous on the west side of the valley than on the east and they obtain the ticks from pasture and other uncultivated land infested by wild mammals. It is obvious, therefore, that if the domestic animals in the valley are rendered tick free by dipping, spraying, or by some other equally effective method, the chances of the infection of human beings will be vastly lessened.

METHODS OF DESTRUCTION.

Experiments are now being made in Bitterroot Valley to discover the most practical methods of destroying the several species of mammals that act as hosts for the fever tick. Excellent formulas have been worked out for poisoning ground squirrels and other rodents in California and elsewhere, but methods which give satisfactory results in one region are often less successful in another or when tried on a different though nearly related species. It is hoped therefore ultimately to replace the formulas here given by others that will prove even cheaper and better.

In distributing poisoned grain to kill rodents too much care can not be exercised to prevent the destruction of game birds and other valuable species. Except under very exceptional circumstances poisoned grain should never be sown broadcast, but should be dropped, a few grains in a place, near the mouths of the burrows, if for ground squirrels, and under stones, pieces of bark or board, or in old tin cans, if intended to be eaten by mice and rats.

GAME ANIMALS.

The removal of protection from any of the big game animals—moose, elk, mule deer, white-tailed deer, goats, and mountain sheep—would result in their speedy disappearance at the hands of hunters, but in and around Bitterroot Valley the numbers of game animals are comparatively small and their range so remote from human habitations that their destruction, on the ground that some of them carry ticks, is unwarranted, especially as it would have little or no effect on attempts to stamp out the fever.

BEARS.

Bears have proved prolific hosts for ticks in the Bitterroot region. In the past they have been both trapped and hunted, and vigorous efforts will probably secure what remain. They are successfully followed with dogs and are easily trapped.

FUR-BEARING ANIMALS.

Furs are now so high that if a reduction in the number of fur bearers is thought desirable, it is necessary only to remove the restrictions on trapping in any given area, when trappers will concentrate their efforts there and soon diminish the numbers.

WOLVES AND COYOTES.

Full directions for trapping and poisoning wolves and coyotes are given in Circular No. 63 of the Biological Survey. Scent baits composed of putrid meat, sperm oil, or any liquid animal oil, asa-

fetida, and musk or beaver castor, are recommended for trapping. For poisoning, pure sulphate of strychnine should be used in gelatin capsules, 3-grain capsules for wolves and 2-grain capsules for coyotes.

WOODCHUCKS.

Woodchucks are so easily trapped and shot that persistent effort only is needed to rid a locality of them. Very little is known in regard to baits and poisons for this animal. It is believed that green corn or carrots treated with the standard strychnine-starch solution will prove effective. When woodchuck burrows are made in the soil, and not among rocks, carbon bisulphid is the most certain remedy. (For method of application see below.)

COLUMBIAN GROUND SQUIRREL.

These squirrels feed so largely on green vegetation during the summer that they are difficult to poison. They take poisoned grain, however, freely on their first appearance in spring when green food is scarce and in August just before entering hibernation. The best results have been obtained with the following bait:

Clean oats.....	8 quarts.
Strychnine sulphate.....	1 ounce.
Saccharin.....	$\frac{1}{2}$ teaspoonful.
Thin starch solution.....	2 $\frac{1}{2}$ quarts.

Dampen the oats with hot water and drain after a few minutes. Dissolve the strychnine in the hot starch solution; mix in the saccharin. Apply to dampened oats and allow to stand at least 48 hours. Spread and dry. Distribute early in morning, scattering liberally about squirrel holes.

In cultivated lands trapping these squirrels with the No. 1 steel trap by both "hole" and "surface" sets is very effective. Traps should be visited at least twice a day to prevent unnecessary suffering of trapped animals.

Early in the season before the ground dries the use of carbon bisulphid as given in Circular 76 is highly recommended.

Crude carbon bisulphid, suitable for killing ground squirrels, prairie dogs, and other burrowing animals, costs about 8 cents per pound in 50-pound carboys or drums. It is a volatile liquid and rapidly loses strength on exposure to the air; hence it should be kept in tightly corked bottles or cans. It should not be introduced haphazard, but should be used only in burrows where the animals have been seen to enter immediately before it is applied, so that none may be wasted. It should be employed in the following manner:

Half tablespoonful of crude bisulphid should be poured on a piece of cotton waste or other absorptive material; this should be pushed as far as possible down the burrow and the opening closed immediately.

Bisulphid can be used to best advantage after a rain, when the interspaces in the soil are filled with water, so that the fumes are less readily diffused into the surrounding ground.

In colonies where the holes are close together half an ounce of the bisulphid is enough for each burrow, but in the case of solitary burrows a full ounce should be used.

As carbon bisulphid is inflammable and the fumes highly explosive, it should never be opened near a fire or where a person is smoking.

SMALLER SPECIES OF GROUND SQUIRRELS AND CHIPMUNKS.

The two species of chipmunks and the side-striped ground squirrel feed extensively on seeds and are fond also of grain. They can readily be poisoned with a preparation of strychnine, starch, and wheat. The following is the formula:

I.

Wheat.....	1 bushel.
Water.....	1 quart.
Starch.....	2 tablespoonfuls.
Saccharin.....	2 teaspoonfuls.
Strychnia (pulverized).....	2 ounces.

Add the starch, saccharin, and strychnia to the water; heat to boiling and stir constantly after the starch begins to thicken. When the starch is fully cooked, stir it into the wheat, every kernel of which should be coated. A galvanized iron washtub is an excellent mixing vessel, especially as it is easily cleaned. Either the sulphate or the alkaloid of strychnia may be used.

During rainy weather it is better to substitute melted tallow for the starch solution as a coating medium. In this case, the wheat should first be slightly warmed and the saccharin and strychnine added, and then the tallow applied, in the proportion of a quart to a bushel of wheat.

II.

Coarse crackling meal.....	$\frac{3}{4}$ quart
Strychnine (alkaloid).....	30 grains ($\frac{1}{16}$ ounce)

Chop lard cracklings to coarse meal (containing chunks one-quarter to one-half inch square). With a salt shaker, slowly add the powdered strychnine, mixing constantly to distribute it evenly. Add one-quarter quart of fine crackling meal and mix well, to cover the strychnine and disguise its bitter taste.

PINE SQUIRRELS.

Shooting and trapping seem to be the most practical methods of reducing the numbers of pine squirrels, as they do not take poison readily.

MICE AND WOOD RATS.

While the food habits of the several species of mice in Bitterroot Valley vary considerably, all the species, and also the wood rat, are fond of grain, and may be readily poisoned with the wheat, starch, and strychnine preparations given on page 7. The manner of distributing the poisoned grain most effectively depends on the habits of each species, which are briefly outlined in the following pages.

POCKET GOPHERS.

Pocket gophers rarely leave their underground burrows, but they are easily caught in traps. By following the directions here given, they may be poisoned with a preparation of strychnine and corn or other grain, or strychnine in raisins, prunes, or small potatoes.

Dissolve an ounce of strychnia sulphate in a pint of boiling water. Add a pint of thick sugar sirup, and stir thoroughly. The sirup is usually scented by adding a few drops of oil of anise, but this is not essential. If preserved in a closed vessel, the sirup will keep indefinitely.

The above quantity is sufficient to poison a half bushel of shelled corn or other grain (corn recommended). The grain is steeped in hot water and allowed to soak over night. It is then drained and soaked for several hours in the poisoned sirup. Before using, corn meal may be added to take up the excess of moisture.

Dry crystals of strychnine also may be used. They are introduced, by means of a knife, into small pieces of potato, beet, carrot, or sweet potato or into entire raisins or dried prunes. A single large crystal (or several small ones) is enough for each bait. Raisins are especially recommended because they are easily handled and contain enough sugar to disguise the bitterness of the poison.

The baits having been prepared, the operator inserts them one by one into the gopher tunnels. The tunnels may be readily located by the use of a pointed stick or a prod consisting of a spade handle shod with a metal point and having a metal bar for the operator's foot about 15 inches from the point. The prod when withdrawn leaves a hole through which the bait may be dropped into the gopher runs. The hole may be covered or left open; no difference in results has been noticed. The prod saves the labor of digging down to the tunnel and enables a man in a day to distribute gopher poison to 30 or 40 acres of badly infested alfalfa land or meadow. For loose soils a pointed stick will answer, but for sod or harder soils the iron-pointed prod with foot bar is far better.

RABBITS.

Rabbits are more easily poisoned in winter when green food is scarce and they eagerly eat well-cured alfalfa hay. The formula

recommended is 30 pounds of chopped alfalfa hay, 1 ounce of strychnia sulphate, and 5 or 6 gallons of water. Sprinkle this solution over the hay chopped into 2-inch lengths until it is absorbed, then sack the hay and it is ready for use. It can be distributed in the rabbit runways, on the snow, or on their feeding grounds. This preparation will doubtless kill rock conies (*Ochotona*) also if distributed in their rock slides in spring or placed in their "haystacks" in fall.

Chopped fruit-tree prunings (2 to 3 inch lengths), treated with strychnine-starch solution (p. 7), is an effective poison for rabbits. It has the added advantage of not endangering the lives of birds or stock.

PORCUPINES.

Porcupines are usually not numerous and are easily tracked on snow and shot or trapped at their dens. Where their dens are among inaccessible rocks they can probably be poisoned with strychnine in potatoes or carrots, of which they are very fond. A dose of the poison as large as 2 or 3 grains may be necessary. Porcupines are exceedingly fond of salt and will travel considerable distances to secure it. Apples, carrots, potatoes, or chopped twigs from fruit trees (2 inches long) coated with the starch-strychnine solution with salt added should prove effective.

LIST OF MAMMALS FOUND IN AND NEAR BITTERROOT VALLEY, MONTANA.

By CLARENCE BIRDSEYE.

In the following list are mentioned all the species of mammals known to occur in Bitterroot Valley and the adjacent mountain slopes. A star before a name indicates that ticks were found on one or more individuals of the species. It may be added that while no ticks were found on the particular individuals of a number of species collected, further investigations may be expected to reveal their occasional presence on some of them.

For determination of the several species of ticks mentioned in this paper we are indebted to the Bureau of Entomology.

* MULE DEER.

(*Odocoileus hemionus*.)

Mule deer occur more or less commonly on the lower slopes of the mountains on both sides of the Bitterroot from Missoula south to the head of the valley, as well as in surrounding mountains and valleys. Deer occasionally wander down into the fields of the Bitterroot Valley and I have seen their tracks on the school section at Florence. In the more accessible parts of their range they seem to be rapidly becoming scarcer, but on the South Fork of the Bitterroot they are more abundant this year (1910) than for several years past.

Five individuals were examined about May 19, 25 miles south of Darby, but on only one of them was a tick found—an adult *Derma-centor albipictus* attached to the anus. Ticks were not abundant in the locality where these animals were taken, and it is probable that in other situations deer more frequently serve as hosts for ticks.

WHITE-TAILED DEER.

(*Odocoileus leucurus.*)

White-tailed deer are bottom-land animals, in contrast to the mule deer, which range principally in the foothills and mountains. They occur in suitable places along the Bitterroot River from Missoula to Darby, and also along those tributaries of the Bitterroot whose bottom lands afford them congenial cover. On the creeks they range well up into the mountains, at least as high as 5,500 feet. The only specimen examined was taken June 25 near Packers Meadow, Idaho, and was free from ticks. This may have been due to the fact that there were very few ticks in that locality.

ELK.

(*Cervus canadensis.*)

Elk were formerly abundant in the mountains on both sides of the Bitterroot Valley, but they are now scarce, only a few small bands and roaming individuals remaining in this part of Montana. A cow elk shot on May 17 at Lake Como had no ticks on it, although ticks were numerous where it was shot.

MOUNTAIN SHEEP.

(*Ovis canadensis.*)

Sheep formerly occurred in suitable localities throughout a large part of the Bitterroot Mountains and the range east of the valley, but they are now mainly restricted to higher parts of the ranges about the head of the valley. None were taken.

•
MOOSE.

(*Alces americanus.*)

Moose were once common in parts of the Bitterroot Valley, and a few are reported still in the mountains to the east and west, but mainly on the outside slopes.

* MOUNTAIN GOAT.

(*Oreamnos montanus.*)

Mountain goats seem to be still fairly common over most of their range in the Bitterroot Mountains and in the mountains southeast

of Darby. I shot three in the middle of May on Rock Creek near Lake Como, and secured records of their occurrence on Bass, Mill, Blodgett, Sawtooth, Lost Horse, and other creeks entering the Bitterroot from the west. They inhabit the broken precipices along the creeks at from 5,000 to 7,500 feet altitude.

I believe that in proportion to their numbers mountain goats serve more frequently as hosts for fever ticks (*Dermacentor venustus*) than do any other wild animals. Of the three individuals shot each was infested with a hundred or more adult and a few nymphal ticks. Hunters say that goats killed at all seasons harbor ticks, which are very abundant on the goat rocks where there are no other large mammals. Many *Dermacentor albipictus* also were found on these goats.

FLYING SQUIRREL.

(*Sciuropterus alpinus*.)

Flying squirrels occur throughout the higher forests of the Bitterroot Mountains and occasionally follow the creek well down into the valley. Two adult and several young of this species were examined and all were tick free. The number examined is insufficient to prove a negative, but the nocturnal and arboreal habits of these squirrels may render them immune from ticks.

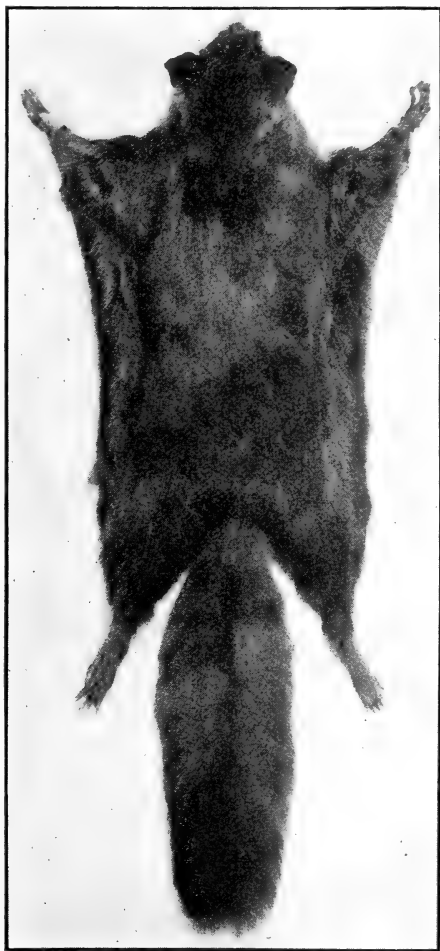


FIG. 1.—Flying squirrel (*Sciuropterus alpinus*). (About $\frac{1}{3}$ natural size.)

* PINE SQUIRREL.

(*Sciurus hudsonicus richardsoni*.)

Pine squirrels are abundant throughout the coniferous timber of the Bitterroot Valley and adjacent mountains. Most of those secured in good "tick country" were found to be infested with nymphal or seed ticks, several dozen seeds being taken from one squirrel. Most

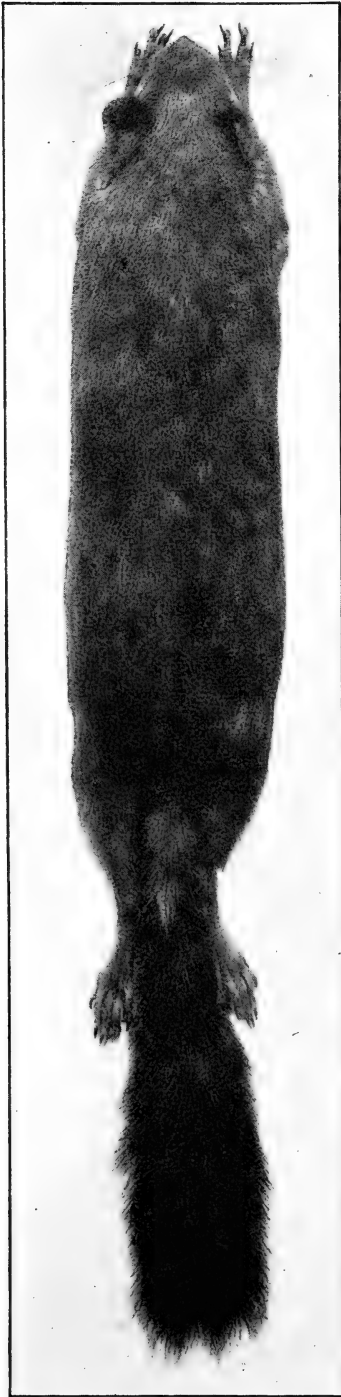


FIG. 2.—Pine squirrel (*Sciurus hudsonicus richardsoni*). (About $\frac{1}{2}$ natural size.)

[Cir. 82]

of these ticks were *Dermacentor venustus*, but several seeds and nymphs belonged to the genus *Ixodes*. Pine squirrels sometimes enter camps and houses, and might carry ticks with them. They are active throughout the year, living in hollow trees or nests in the branches. They are readily shot and trapped and undoubtedly could be destroyed with poisoned grain or nuts.

* YELLOW-BELLIED CHIPMUNK.

(*Eutamias luteiventris*.)

These yellow-bellied chipmunks are common in suitable places throughout Bitterroot Valley and the adjacent foothills and up to 4,500 feet on warm slopes. They are to be found in all sorts of country except the open sage-covered bench land on the east side of the valley, and usually occur wherever the fever tick flourishes. In the spring of 1910 the chipmunks first began to emerge from hibernation on March 17, and by the early part of April were out in full numbers. In autumn they were reported as entering hibernation again about Thanksgiving. Most of those taken in good "tick country" proved to be infested with nymphs, or seeds, of the fever tick (*Dermacentor venustus*). One hundred and twelve were examined.

* WHITE-BELLIED CHIPMUNK.

(*Eutamias quadrivittatus umbrinus*.)

The white-bellied chipmunks occur in the mountains mainly above the range of the last species. They inhabit open rocky hillsides, old burns, where there is plenty of fallen timber, and rock slides, from about 3,700 feet to 8,100 feet altitude, in the mountains

on both sides of the valley. This is one of the few small mammals found on the goat rocks, and may serve as a host for many of the seeds and nymphs of the fever ticks which in the adult stage feed on the goats. Twenty-nine of these chipmunks—most of them taken in poor tick country—were examined and only one tick was found. This was a nymph of *Derma-centor venustus*.

* COLUMBIAN GROUND
SQUIRREL.

(*Citellus columbianus*.)

Columbian ground squirrels (commonly called "picket pins") are abundant throughout the whole length of the valley and from the river well up into the mountains on both sides. They were taken on Sweeney Creek up to 7,000 feet. I believe that on the whole they are very much more numerous on the west side of the valley, for they are practically absent from the wide belt of rolling sagebrush benches on the east side. In the valley they seem most numerous in stony fields, although abundant also in

meadows, hayfields, and open pine woods. In the mountains they prefer open-timbered southern slopes. They usually hibernate late in August and begin to emerge from hibernation toward the end of March. They were out in full force by the 10th of April. Between

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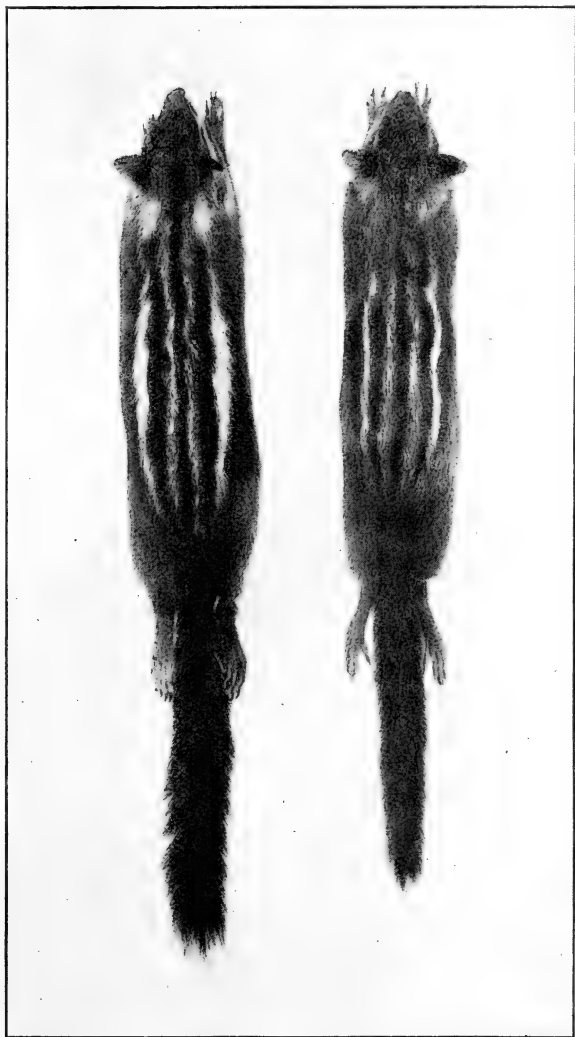


FIG. 3.—1, White-bellied chipmunk (*Eutamias quadrivittatus umbrinus*); 2, yellow-bellied chipmunk (*Eutamias luteiventris*). (About $\frac{2}{3}$ natural size.)



FIG. 4.—Columbian ground squirrel (*Citellus columbianus*). (About $\frac{2}{3}$ natural size.)

[Cir. 82]

150 and 200 "picket pins" were examined, and practically all those taken in good "tick country" were found to serve as hosts for the younger stages of *Dermacentor venustus*. On many of them were several dozen nymphs or seeds; from one, 62 nymphs were taken, and from another over 100 seeds. No adult ticks were found on them. It is probable that this ground squirrel raises more young fever ticks than does any other species, possibly more than all other species of animals combined. Nymphs and seeds were found on ground squirrels taken from under stables and unoccupied cabins, and it is probable that they often drop engorged ticks under such buildings. The fact that practically 100 per cent of these squirrels artificially infected with spotted fever in captivity have contracted the disease in mild form is significant.

One of the most important and fundamental steps in the control of the fever is unquestionably a determined and concerted effort to lessen the number of picket pins, especially in pastures and around dwellings. These animals are so destructive to crops that any expense incurred in destroying them will be well repaid by the resulting freedom from their depredations.

* SIDE-STRIPED GROUND SQUIRREL.

(*Callospermophilus lateralis cinerascens*.)

The little side-striped ground squirrels are abundant on the lower slopes of the mountains on both sides of Bitterroot Valley throughout its length. They seem to prefer

warm rocky slopes and the vicinity of small settlements in the foothills. They were especially abundant around Lo Lo Hot Springs and near the construction buildings at Lake Como. They are true ground squirrels and hibernate at an earlier date than the chipmunks, usually about the 1st of September, reappearing in March. They live largely on seeds and grain and, when necessary, can be readily poisoned. Under favorable circumstances they serve as hosts for ticks, and from four out of the five specimens captured at Woodman were taken nymphal and seed ticks of *Dermacentor venustus*.

* WOODCHUCK.

(*Marmota flaviventris*.)

Woodchucks are generally distributed along both sides of the valley and in the adjacent foothills. They are especially abundant in rock piles and around vacant buildings along the valley's edge. From one rock pile in a hayfield near Florence I took 15 woodchucks; and from under the unoccupied buildings on the ranch at the mouth of Bass Creek 6 specimens were taken. The first one was noted on March 24, and most of them had emerged from hibernation by the end of the month. By the middle of August most of them had again "holed up." About 25 of these animals were examined for ticks, and it was found that they commonly serve as hosts for nymphs and seeds of *Dermacentor venustus*. On one were found two adults of this species; and adults were found to attach and engorge on woodchucks in captivity. It would probably not be very difficult to exterminate these harmful rodents in the cultivated fields and around ranches.

HOARY MARMOT.

(*Marmota caligata*.)

These big mountain woodchucks, hoary marmots, or "whistlers," occur mainly above timberline in the Bitterroot Mountains, and are not abundant there. None were examined.

[Cir. 82]

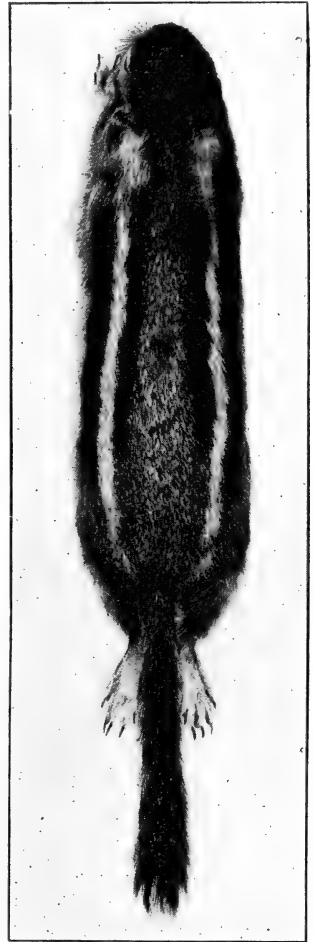


FIG. 5.—Side-striped ground squirrel (*Callospermophilus lateralis cinerascens*). (About $\frac{1}{2}$ natural size.)

HOUSE MOUSE.

(Mus musculus.)

House mice are common in the fields and brush as well as in and around farm buildings in the valley, but none were examined for ticks.

* WHITE-FOOTED MOUSE.

(Peromyscus maniculatus artemisiæ.)

The white-footed mouse is probably the most generally distributed mammal of the valley, and occurs throughout its entire length and from the river well up on to the mountains. It was taken in every sort of country—under fallen logs, on sage-covered benches, on hot, rocky pine-covered slopes, on cold, damp slopes, in houses and stables, in damp meadows, and in dry fields. They are strictly nocturnal, live mainly on seeds and grain, and are active throughout the year. As most of these mice were taken in guillotine traps, any ticks which might have been on them would in most cases have become detached before the mice were found. One partially engorged *Dermacentor venustus* nymph was, however, taken from the ear of one of these mice caught in a hayfield.



FIG. 6.—White-footed mouse (*Peromyscus maniculatus artemisiæ*). (About $\frac{1}{2}$ natural size.)

* WOOD RAT.

(Neotoma cinerea.)

Wood rats, pack rats, or mountain rats occur in the mountains and along both sides of the valley for practically its whole length. They are to be found in many of the unoccupied cabins near the foothills; and I have seen their signs in rock slides up to 7,500 feet. They are nocturnal, nonhibernating animals of rather omnivorous food habits. Green leaves, flowers, fruit, seeds, grain, nuts, and almost any cooked food from the pantry are acceptable to their taste. Although only one tick, a nymph (genus unknown), was taken from a wood rat, it is probable that under some circumstances they occasionally harbor fever ticks in the young stages.

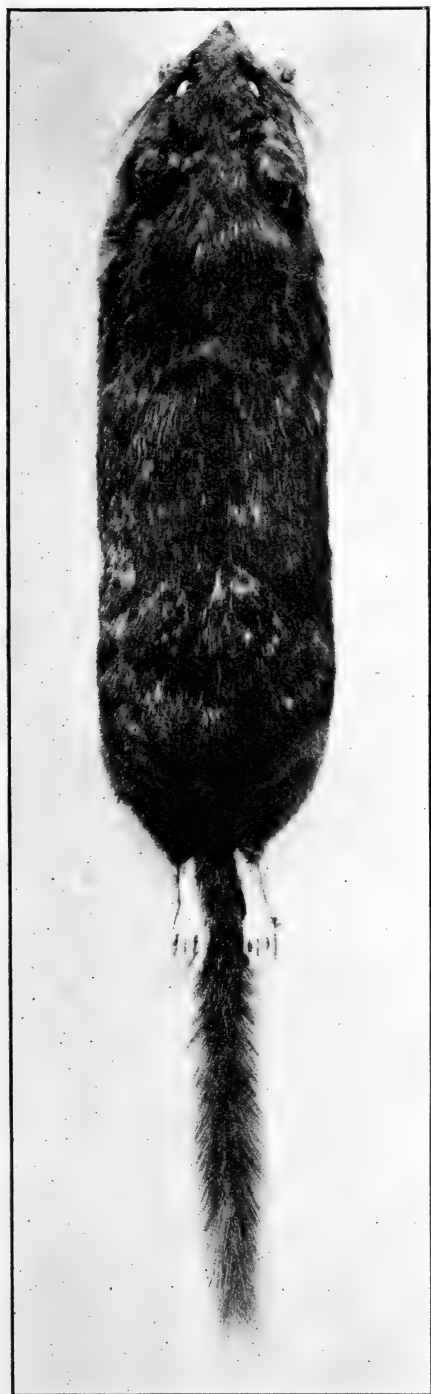


FIG. 7.—Wood rat (*Neotoma cinerea*),
(About $\frac{1}{2}$ natural size.)

[Cir. 82]

RED-BACKED MOUSE.

(*Erotomys idahoensis*.)

The red-backed mouse is common in damp mountain woods and along streams well down into the valley. No ticks were found on the few specimens examined.

* MEADOW MOUSE.

(*Microtus modestus*.)

These large dark meadow mice are common in the meadows along both sides of the valley. On the Densmore Ranch, 3 miles west of Florence, they were very abundant in a rocky run-down hayfield used for pasturing horses. Most of those taken had been dead long enough for any ticks which might have been on them to detach, but on three which were examined while still warm three partially engorged nymphs of *Dermacentor* were found. The natural food of these mice is green vegetation, but they are fond of seeds and grain and can be poisoned very readily. They do not hibernate and can best be poisoned in winter when green food is scarce.

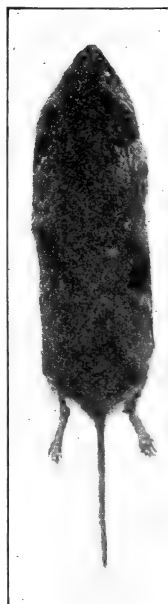


FIG. 8.—Red-backed mouse (*Erotomys idahoensis*).
(About $\frac{1}{2}$ natural size.)

GRAY MEADOW MOUSE.

(Microtus nanus canescens.)

This species of meadow mouse occurs in grassy depressions, on benches, and in upland fields, as well as in marshes and meadows in the valley bottoms. A few were taken, but none were examined

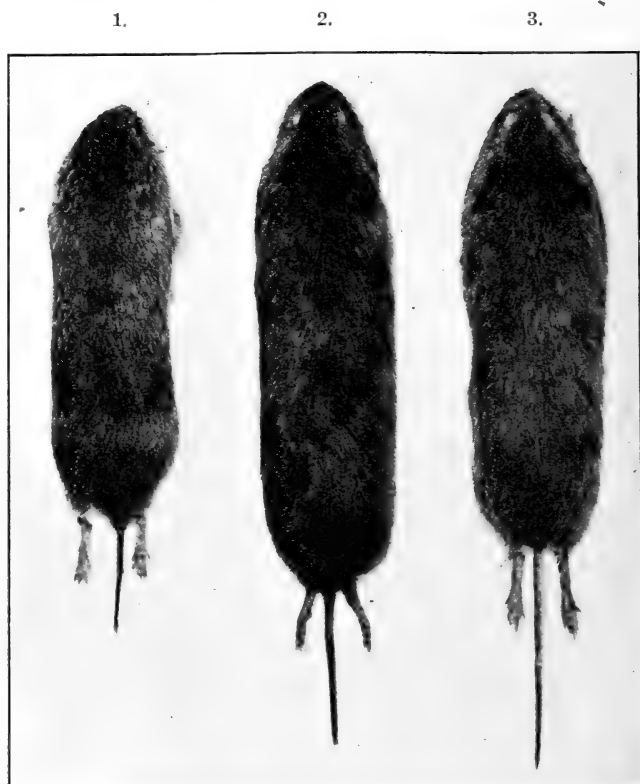


FIG. 9.—1, Gray meadow mouse (*Microtus nanus canescens*); 2, common meadow mouse (*Microtus modestus*); 3, long-tailed meadow mouse (*Microtus mordax*). (About $\frac{1}{2}$ natural size.)

for ticks. In habits they differ very little from the darker colored *modestus*, with which they often occur.

LONG-TAILED MEADOW MOUSE.

(Microtus mordax.)

These mice occur principally in the mountain meadows and along creeks down into the edges of the valley. They are usually not very numerous or of much economic importance except as food for hawks, owls, weasels, foxes, and wild cats. They feed mainly upon green vegetation, and are more partial to water and wet ground

than the other meadow mice. In winter they are active under the deep snow.

MUSKRAT.

(*Fiber zibethicus osoyoosensis.*)

Muskrats were formerly common in most of the sloughs and ponds in the valley, but the extremely high price paid recently for their pelts has led to a great reduction in their numbers. One was shot, but no ticks were found on it. Their aquatic habits may exempt them from such pests.

BEAVER.

(*Castor canadensis.*)

Beavers occur in the Bitterroot River and on Lo Lô and other creeks, but they are very scarce. None were examined, but it seems improbable that they would be attacked by ticks.

POCKET GOPHERS.

(*Thomomys fuscus.*)

Pocket gophers are common over most of the valley and in mountain parks and meadows. Specimens were taken on Ambrose Creek and west of Florence, but no ticks were found on any of those examined. They probably do not serve as an important host for the fever tick, as their lives are spent almost entirely underground. Still ticks are occasionally found on gophers in other localities. Pocket gophers do considerable damage to crops, especially to garden vegetables, orchards, and nurseries, but are easily poisoned or trapped.

JUMPING MOUSE.

(*Zapus princeps.*)

The jumping mouse occurs in suitable places throughout the valley and lower parts of the adjacent mountains. Only a dozen specimens were secured, and although none of them had ticks on them, it is probable that they sometimes serve as hosts for nymphs or seeds. Unlike other mice in the valley, they hibernate in winter, denning up with the first hard frosts. They live mainly upon seeds of grass and other plants, and are fond of rolled oats and any of the small grains.

[Cir. 82]



FIG. 10.—Pocket gopher
(*Thomomys fuscus*).
(About $\frac{1}{2}$ natural size.)

* PORCUPINE.

(Erethizon epixanthum.)

Porcupines occur sparingly in the mountains on both sides of the valley and occasionally wander down into the bottoms. On a porcupine caught in an unoccupied cabin at Elk Lake (on Bass Creek) there were two partially engorged adult ticks. These ticks were lost, but they looked like *Dermacentor*.



FIG. 11.—Jumping mouse (*Zapus princeps*). (About $\frac{1}{2}$ natural size).

* ROCK CONY; PIKA.

(Ochotona princeps.)

Rock conies, or "rock rabbits,"¹ as they are sometimes called in the Bitterroot, occur in the rock slides in the higher parts of the mountains on both sides of the valley. Practically all of the 12 examined were infested with seeds, nymphs, and adults of *Ixodes*, but none bore fever ticks.

* SNOWSHOE RABBIT.

(Lepus bairdi.)

Snowshoe rabbits occur in the mountains and in the brushy and timbered parts of the valley. Three specimens were examined for ticks and on two of them were found over 1,000 seeds, nymphs, and adults of the rabbit tick (*Haemaphysalis leporis-palustris*). From each of these two, also, an adult fever tick was taken.

WHITE-TAILED JACK RABBIT.

(Lepus campestris.)

Jack rabbits are common in open country on the east side of the valley south at least to Darby. None were seen on the west side, although they occasionally occur there. No specimens were taken, but like other rabbits they are known to serve commonly as hosts for ticks.

* COTTONTAIL.

(Sylvilagus nuttalli.)

Cottontails are common in brushy places in the Bitterroot Valley from the river well up into the foothills. Although several were shot in a locality badly infested with ticks, none harbored the pests.

¹ The name "rock rabbit" is applied also to the cottontail of the valley, and more properly, as it is a rabbit and also lives commonly among rocks.

One shot near Stevensville in September, 1908, by Vernon Bailey was well covered with ticks, some of which were identified by Mr. Bishopp and later by Mr. Banks as *Ixodes diversifosus*. The fever tick also was found on four specimens.

MOUNTAIN LION.

(*Felis hipolestes*.)

Mountain lions occur sparingly in the mountains on both sides of Bitterroot Valley. None were taken.

CANADA LYNX.

(*Lynx canadensis*.)

Canada lynxes occur in the mountains on both sides of this valley and occasionally wander down to the river, but persistent trapping during the last three years has greatly reduced their numbers. None were taken.

BOBCAT.

(*Lynx uinta*.)

Bobcats occur occasionally along the edge of the valley, but none were taken.

WESTERN RED FOX.

(*Vulpes macrourus*.)

A few cross-foxes and rarely a silver gray are caught in the mountain valleys around the head of the Bitterroot, but they occur rarely, if at all, in the bottom of the valley.

GRAY WOLF.

(*Canis occidentalis*.)

Wolves are said to pass occasionally through the Bitterroot Valley. None were taken.

* COYOTE.

(*Canis lestes*.)

Until the last year or two, coyotes were common in the valley throughout its length, but persistent hunting and trapping have



FIG. 12.—Rock cony (*Ochotona princeps*). (About $\frac{1}{2}$ natural size).

recently reduced their number considerably. On one caught in an orchard on the Densmore ranch, near Florence, in May, there were a number of adult fever ticks. No other coyotes were taken.

* BLACK BEAR.

(*Ursus americanus*.)

Black bears are rather common in the mountains on both sides of the valley, and they occasionally wander down to the river. Trappers say that the bears are usually much infested with ticks, and I found several dozen specimens of *Dermacentor venustus* on a bear shot near Woodman on June 30.

GRIZZLY BEAR.

(*Ursus horribilis*.)

Grizzly bears are now rare, but occur in the higher parts of the mountains on both sides of the valley. None were taken; but as the black bear frequently serves as a host of the tick, it is natural to suppose that the grizzly does also.

SKUNK.

(*Mephitis hudsonica*.)

Skunks occur in the valley, and, although I took none, records of them were secured at Lo Lo, Stevensville, and Corvallis. In other localities skunks frequently serve as hosts for certain species of ticks, and it is probable that they occasionally do for fever ticks in the Bitterroot.

* BADGER.

(*Taxidea taxus*.)

Badgers are plentiful in the valley throughout its length and from the river up to at least 5,600 feet in the mountains on both sides. Only one specimen was taken—near Florence on April 5—and on it was found one dead adult male *Dermacentor venustus*.

OTTER.

(*Lutra canadensis*.)

A few otters wander along the Bitterroot River and some of its principal tributaries, but they are rarely taken.

* WEASEL.

(*Putorius arizonensis*.)

Weasels occur in the valley but are not common. In the mountains they are said to be abundant. On a weasel shot in a rock slide inhabited by conies on Bass Creek June 15 were found four adult ticks of the genus *Ixodes*.

MINK.

(*Lutreola vison encyrgumenos.*)

Minks occur sparingly along the Bitterroot River and some of its principal tributaries. None were examined for ticks.

FISHER.

(*Mustela pennanti.*)

Occasionally fishers are taken in the mountains on both sides of the valley, but I secured none.

* MARTEN.

(*Mustela c. origenes.*)

Martens are rather plentiful in the mountains on both sides of the Bitterroot River and afford one of the staple furs of the region. From one caught early in March on Bass Creek a species of *Ixodes* was taken.

WOLVERENE.

(*Gulo luscus.*)

An occasional wolverene is caught by trappers in the mountains around the valleys, but they are becoming rare.

COMMON SHREW.

(*Sorex personatus.*)

These little shrews occur in the grass-grown depressions on the benches on the east side of the valley and were found also in a dry hayfield southwest of Florence. None were examined for ticks, and they are probably too small to harbor anything but seed ticks.

DUSKY SHREW.

(*Sorex obscurus.*)

These shrews are common in damp meadows and swamps throughout the valley up to at least 3,700 feet. Many specimens were examined, but no ticks found on them.

WATER SHREW.

(*Neosorex navigator.*)

Water shrews occur along the creeks from well up into the mountains down to the river. It is highly improbable that they serve as tick hosts.

LITTLE BROWN BAT.

(Myotis lucifugus.)

These little brown bats are common in the valley and spend the day in crevices, in bridges, or buildings. Although 20 or more specimens were examined, none were found to be tick infested.

SILVERY-HAIRED BAT.

(Lasionycteris noctivagans.)

Three of these dark-colored bats were shot, June 19, 2½ miles southwest of Florence.

BROWN BAT.

(Eptesicus fuscus.)

Only one of these bats was shot.

[Cir. 82]



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